VERMONT RESIDENTIAL FUEL WOOD ASSESSMENT 1997-1998

December 2000

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DPS Technical Report #48

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Highlights

- During the 1997-1998 heating season, 31% of Vermont households burned wood for at least some space heating. Usage of wood for space heat has declined from 48% (1985-1986) to the current 31%. Usage declined 15% since the last survey covering the 1995-1996 season. While usage of wood as a primary fuel has declined markedly (42% in 1981-1982 to 16% in 1997-1998), usage as a supplemental fuel has increased (11% in 1981-1982 to 15% in 1997-1998). About half of the 1997-1998 wood burning households used wood as the primary fuel, and half used wood as a supplemental fuel.

- Vermont households burned an estimated 250,000 cords of wood in 1997-1998. This is a decrease of 45,000 cords (15%) from the estimated 295,000 cords used during the 1995-1996 heating season. The winter of 1997-1998 had 9% fewer heating degree days than the winter of 1995-1996.

- Fifty-four percent of Vermont households burning wood purchased their wood rather than cutting it themselves. Most of the purchased wood (135,975 cords) was purchased cut and split (94,732 cords).

- The average household using wood as the primary heating fuel burned 4.8 cords of wood during the 1997-1998 heating season; the average household using wood as a supplemental heating fuel burned 2.1 cords. Usage per primary burner has declined from 5.9 cords in 1982 to the present 4.8 cords. Usage per supplemental burner has declined from 2.7 cords in 1982 to the present 2.1 cords.

- Three percent (7,500 households) have installed or planned to install a new wood heating system for the 1997-1998 heating season. This is an increase over the average of .75% planning to install a wood heating system during 1990-1996.

- Oil, wood, and natural gas/propane (in that order) have been the three most often used fuels for space heating in all of the surveys. Over the 1982-1998 period, oil, wood, and electricity have decreased in usage while propane and natural gas have increased.

- The random sample survey of 482 households throughout the state was conducted by telephone during January and February 1999. Sample estimates based on the entire sample have errors of approximately plus or minus 4.5%.

Introduction

In January and February of 1999, the Energy Efficiency Division of the Vermont Department of Public Service (DPS) and the Vermont Department of Forests, Parks and Recreation (FPR) conducted a random sample telephone survey of 482 Vermont households.[1] The DPS and FPR developed the survey and produced the tabulations.

This survey continues a series of earlier surveys designed to assess residential wood demand in Vermont. Prior studies of residential wood fuel demand were conducted of the 1981-1982, 1983-1984, 1985-1986, 1987-1988, 1989-1990, 1991-1992, 1993-1994, and 1995-1996 heating seasons. See previous Vermont Department of Public Service Residential Fuel Wood Assessments for the results of previous surveys. This report includes comparable data from all of the previous studies. In some cases the numbers here will differ from what was previously published.[2] The earlier data have been thoroughly examined and corrected as needed. (See Appendix II for details.)

The work on which this report is based was funded, in part, by the Vermont Department of Public Service and the Vermont Department of Forests, Parks and Recreation through a grant from the Northeast Regional Biomass Program.

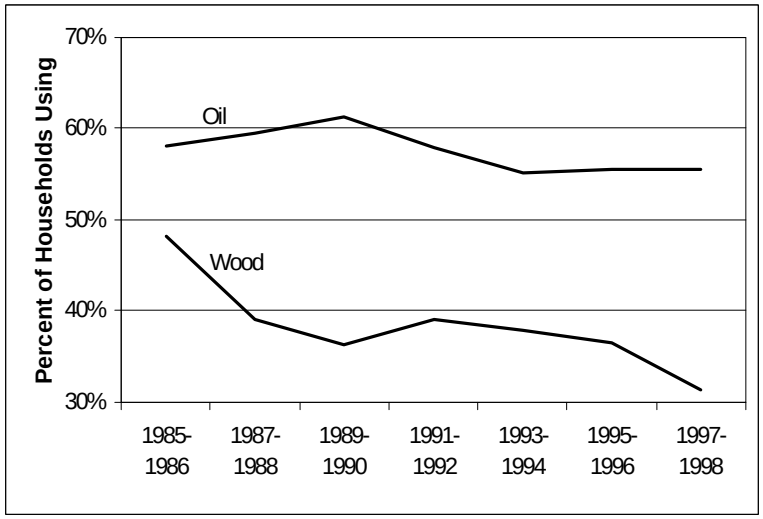
[1]The survey details are in Appendix II.

[2]The 1997-1998 survey used an improved methodology which reached households with either a listed or unlisted number. Previous surveys used only listed numbers. Small differences between prior surveys and the 1997-1998 survey may be the result of this change in methodology.

Fuels for Space Heating

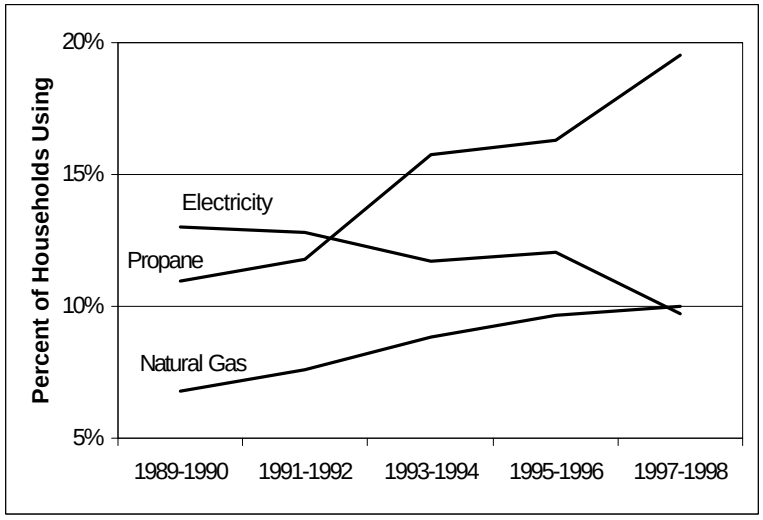
Oil and wood were by far the most popular fuels used for space heating in Vermont households during the 1997-1998 heating season. Fifty-five percent of Vermont homes used oil and 31% used wood as a primary or supplemental fuel source for space heating (Table 1).[3] Oil is the heating fuel which has been used by more than half of the households throughout the period of the surveys. In contrast, the use of wood as a heating fuel has declined dramatically during these years (Figure 1).

Figure 1 - Oil and Wood as Fuels for Space Heat



The use of electricity for space heating has decreased from 15% in 1991-1992 and before to 8% in 1997-1998.[4] Natural gas usage has increased from 5-6% in 1985-1988 to the current 10% while propane has moved from 8% in 1985-1988 to its current 20% (Figure 2).

Figure 2 - Electricity, Propane, and Natural Gas as Fuels for Space Heat, Three Year Moving Average



Coal usage has declined from 2.5% in 1985-1990 to the current .1%. The percentage of households using kerosene or solar energy has not changed during the period of the surveys (Table 2).[5]

[3]All tables are located in Appendix I. The respondent was asked, "Last winter, what kind of fuel provided most of the heat for the home?" If the respondent needed help, the interviewer said that "most" means "the fuel that contributed more heat than any other fuel." The fuel specified by the respondent is regarded as the primary fuel for space heat. The respondent was asked if other fuels were used for space heat, and, if so, what those fuels were. Any fuel so specified was regarded as a supplemental fuel for space heat. The sampling frame was respondents whose primary residence was in Vermont in the previous winter. Vacationers and seasonal residents were not included.

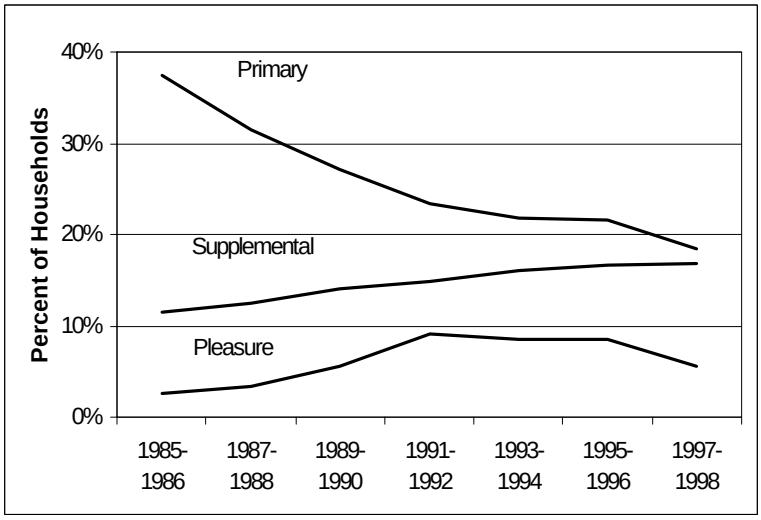
[4]Note that the percentages quoted do not match those shown in the chart. Figure 2, as well as subsequent tables when so indicated, shows three year moving averages ending in the year indicated. Due to considerable year to year variation in the percentages, the moving averages more clearly display long term trends for these fuels. The 95% confidence interval around the 8% electricity estimate is 5.3% to 10.1%.

[5]95% confidence intervals: 7.6% to 12.0% for natural gas, 16.3% to 23.5% for propane, and 6.4% to 11.2% for kerosene.

Wood for Space Heating

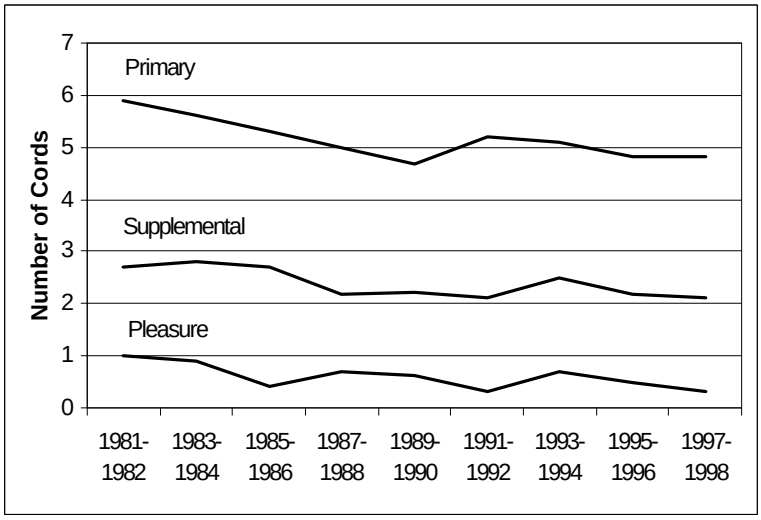
Thirty-one percent of Vermont households (70,083 homes) burned wood for space heating (either primary or supplemental) during the 1997-1998 heating season. Fifty-two percent of those wood burning households used wood as the primary source of space heat during 1997-1998; 48% used wood as a supplemental source of space heat (Table 3). While the percentage of households using wood as the primary fuel for space heat is now less than half of what it was in 1981-1982, the percentage of households using wood as a supplemental fuel has increased. There is some evidence that the percentage of households which burn wood for pleasure, typically in an open fireplace, has increased during this period (Table 4 and Figure 3).[6]

Figure 3 - Type of Wood Burning, Three Year Moving Average



An estimated 250,000 cords of wood were burned during the 1997-1998 season. Primary space heating wood burners used a mean of 4.8 cords while supplemental burners used a mean of 2.1 cords (Table 3). Consumption of wood burned for space heat decreased from the 1995-1996 total of 286,314 cords burned by 81,402 households to 248,522 cords burned by 70,083 households. Since the first survey in 1981-1982, the highest reported use for space heating was 513,810 cords in 1981-1982.

Figure 4 - Mean Cords Burned per Household Using Wood

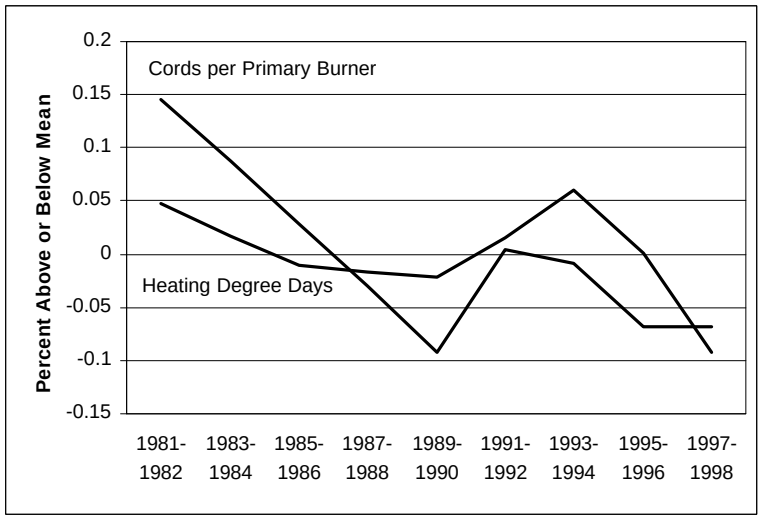


Consumption of wood per wood burning household has declined for all types of wood burners (Table 5 and Figure 4). In part this may be due to greater efficiencies in wood burning appliances or better thermal efficiencies of houses. It may also suggest that even though wood continues to be popular, especially as a supplemental fuel or for pleasure, it is supplying a smaller amount of Vermont's heating load than in previous years.

[6]In 1997-1998 respondents were not asked, as they were in prior years, about their purpose in burning wood. In 1997-1998, respondents who burned wood only in an open fireplace were defined as pleasure burners. This change in methodology may result in a lower than anticipated number of pleasure burners in 1997-1998.

Some of the differences in wood consumption may be attributed to the weather. Although wood consumption in 1997-1998 was lower than in 1995-1996, part of that difference may be explained by the fact that the 1997-1998 heating season was warmer than average and warmer than the 1995-1996 season. Over the years of the Wood Fuel Surveys, there has been a consistent relationship between the number of heating degree days and the number of cords burned by primary burners (Table 6 and Figure 5).

Figure 5 - Effect of Weather on Wood Consumption



In 1997-1998 about 2% of all households burned wood in an open fireplace (a fireplace without a wood stove or fireplace insert) only. Open fireplace burning accounted for a small part of total wood burned. One half of 1% of the total cords were burned in an open fireplace with the average pleasure burning household burning a mean of .3 cords (Table 3).

Demographics of Wood Burners

Using the combined data from the wood fuel surveys from 1991-1998, it is possible to profile some characteristics of wood burners. Respondents were asked if their home was best described as: 1) a one family house detached from any other house (site built rather than manufactured in a factory); 2) a side-by-side duplex (two and only 2, town or row houses with ground floor and roof); 3) a town house (more than two town or row houses with a ground floor and a roof); 4) an apartment or condominium building with two or more units; or 5) a mobile or manufactured home. For purposes of analysis, categories 1 and 2 were combined. Most wood burners (especially primary burners) lived in single family residences. Primary burning was the most frequent kind of burning in both “single family detached or side-by-side duplex” and mobile homes; supplemental burning was most frequent in “single family attached (more than two);” pleasure burning was the most frequent use in “apartments/condos with 2 or more units.” Wood burners typically owned rather than rented their homes (Table 7).

Geography of Wood Burning

The amount of wood burned varied with the geography of the state (Table 9). Figure 6 shows the distribution of wood burned by county.[7] Five counties (Windsor, Rutland, Windham, Washington, and Chittenden), counties with large populations, burned more than half of the wood burned in the state. One might expect that

[7]Figures 6-8 display means calculated from the Wood Fuel Surveys from 1989-1990 to 1997-1998. Using the data from all of the surveys allows the county estimates to be more accurate.

the amount of wood burned would be a reflection of the availability of wood, the ownership of wood burning appliances, and the size of the population in an area. Controlling for size of population by examining the amount of wood burned **per household**, the county distribution changed (Table 9 and Figure 7). The counties with the highest amount of wood fuel consumed per household were in the Northeast Kingdom (Caledonia, Essex, and Orleans). Chittenden and Franklin Counties had the lowest amounts per household.[8]

To burn wood one must have a wood burning appliance. Counties with a high percentage of households with wood burning appliances burned more wood (Table 9 and Figure 8).[9] The Northeast Kingdom had highest percentage of households with wood burning appliances. Chittenden and Franklin Counties had the lowest percentage.

Figure 6 - Wood Burned by County, 1989-1998

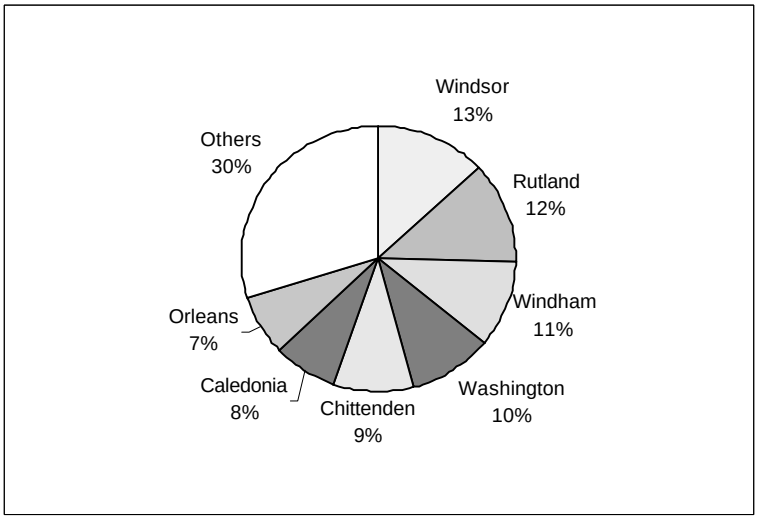
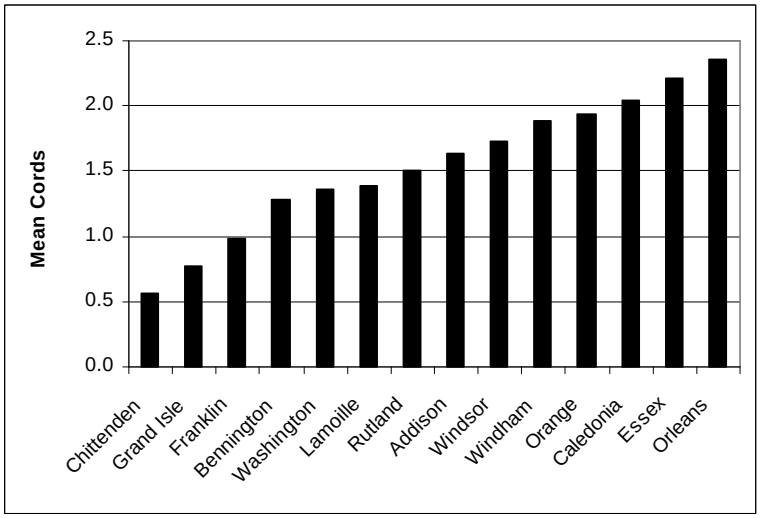


Figure 7 - Mean Cords Burned per Household by County



[8]It may also be true that wood is more readily available and at a lower price in the Northeast Kingdom counties than in Chittenden and Franklin counties.

[9]A household with any kind of wood burning appliance was counted.

Source of Wood

Forty-six percent of all wood acquired in 1997-1998 was cut by the burner or by a friend or family member; fifty-four percent of the wood was purchased. A majority (70%) of the purchased wood was bought as cut and split. (Table 8).[10]

Households burning the most wood bought the wood either in log lengths (mean of 4.6 cords per household) or in unsplit blocks (mean of 3.9 cords per household). Households burning the least wood (mean of 3.0 cords per household) bought the wood cut and split (Table 8).

During the years of the Wood Fuel Surveys, the percentage of households cutting their own wood has declined while the percentage buying wood cut and split has increased. Purchase of log length wood has decreased while purchase of unsplit blocks has remained stable (Table 10).

Figure 8 - Percent of Households with a Wood Burning Appliance by County

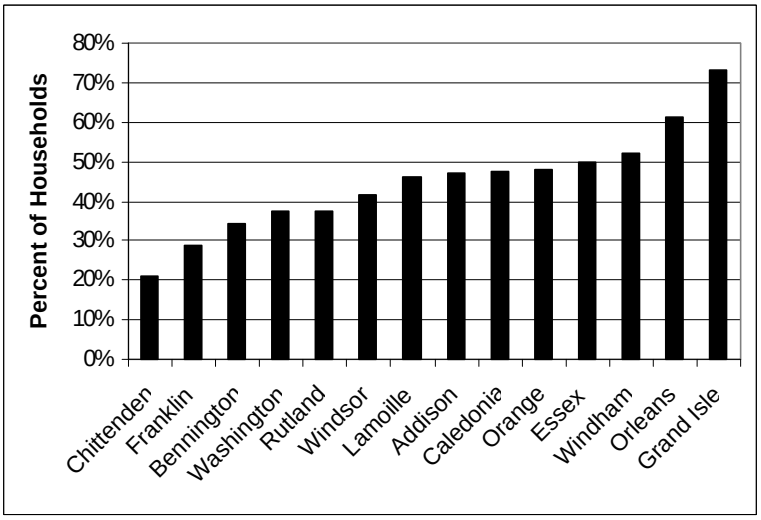
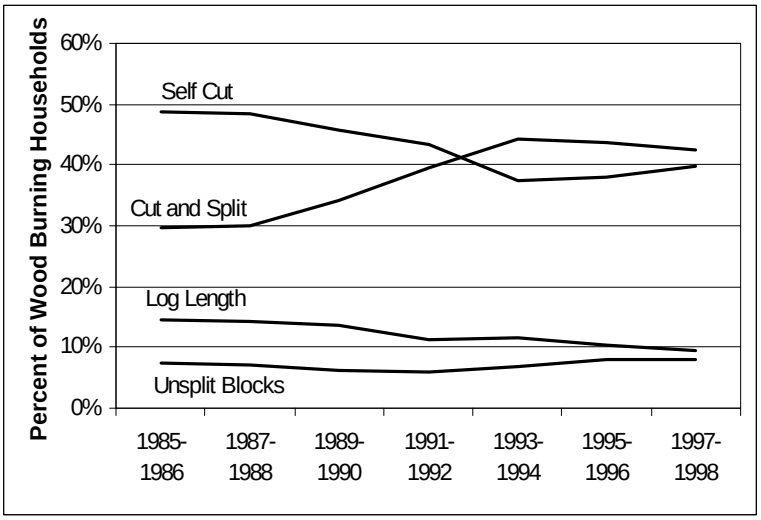


Figure 9 - How Was Your Wood Acquired?



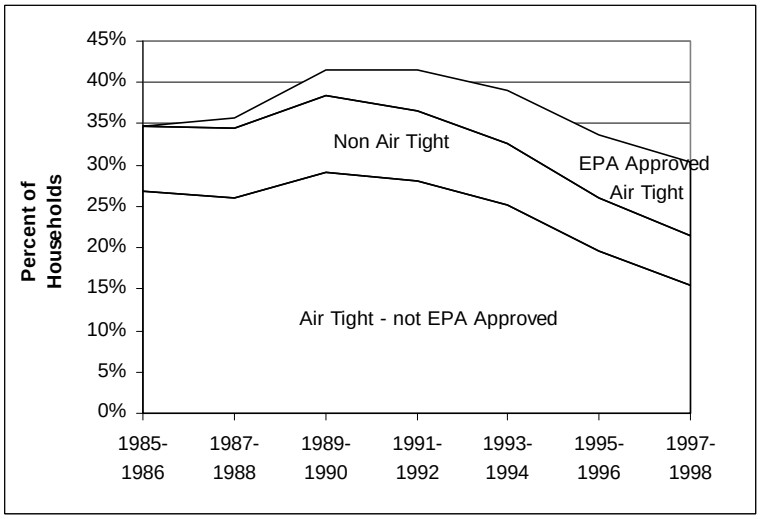
[10]Two respondents indicated that their purchased wood was both cut and split and unsplit. These respondents have been tabulated as having purchased wood cut and split.

Wood Burning Appliances

Table 11 shows the reported usage of various types of wood burning appliances in Vermont households during the 1997-1998 heating season. The most often used appliance is a standard (not EPA approved) airtight stove.[11] Twenty-three percent of the respondents say they have an air tight stove (standard or EPA approved) while 5% say they have an older, non air tight stove.

Ownership of wood stoves has decreased over the period of the surveys.[12] Although the number of EPA approved air tight stoves has increased, the number of air tight stoves overall (EPA approved and non EPA approved) as well as the number of non air tight stoves has decreased.

Figure 10 - Ownership and Usage of Wood Burning Stoves, Three Year Moving Averages



[11]An EPA certified stove is one purchased new after June, 1990.

[12]In 1995-1996 and earlier surveys the question was what appliances do you have in the home. In 1997-1998 the question was what appliances did you use in the last heating season.

In 1983-1984 the following population estimates were obtained: Furnace unspecified: 19,313, stove (type unspecified): 59,084, fireplace (unspecified if open or modified): 6,566. To provide estimates in this report consistent with the other years, we adjusted the 1983-1984 data in the following ways:

> Furnace responses were distributed between wood furnace and combination furnace using the means of the proportion of each in the 1981-1982 and 1985-1986 survey data.
>
> Stove responses were distributed between air tight and non airtight using the means of the proportions in 1981-1982 and 1985-1986 survey data.

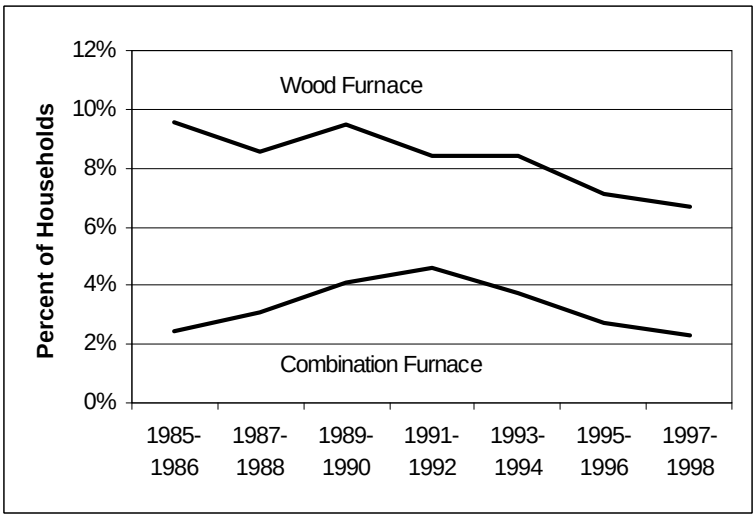
The 1991-1992 questionnaire is no longer available so it was not possible to tell what data corresponded to the EPA approved stove question. Therefore, we took the total air tight stoves indicated by respondents and apportioned them between EPA and non EPA according to the proportions indicated in the previously published (and now superseded) report for 1991-1992.

For surveys prior to 1997-1998 in which it is not known whether or not a wood stove insert in a fireplace is EPA approved, wood stove inserts are included in standard air tight stoves -- not EPA approved.

Although still more popular than combination furnaces, ownership of wood furnaces is down 50% since 1985-1986. The popularity of combination furnaces has changed little (Table 13 and Figure 11).

In 1997-1998 there was an increase in the percentage of households which had installed or were planning to install a new wood burning appliance. Approximately 3% of the survey respondents, representing about 7,500 households, said that they had installed or were planning to install a new wood burning appliance for the 1997-1998 heating season.[13] Not since 1983-1984 have new wood burning appliances been this popular (Table 13). Recent dealer reports of increased wood stove sales accompanied by higher fossil fuel prices lends credence to the survey evidence of increased purchase of wood burning appliances.

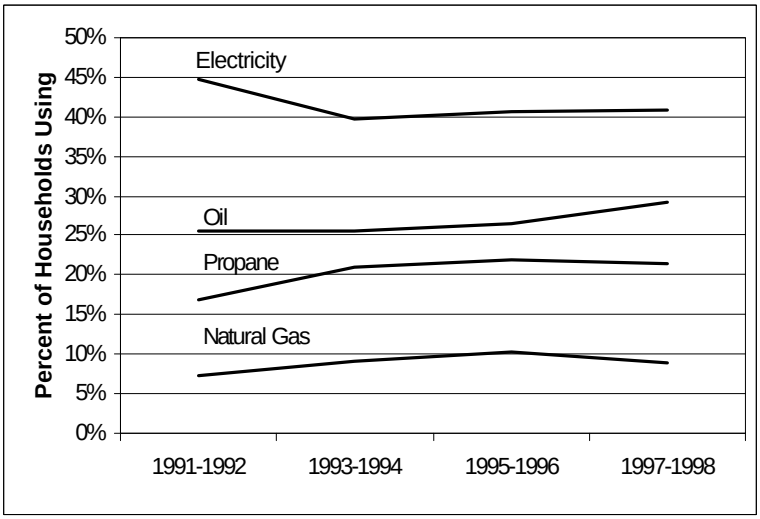
Figure 11 - Ownership and Usage of Furnaces For Burning Wood, Three Year Moving Average



Hot Water Heating

Electricity provided hot water heating for the largest number (41%) of households. Oil and propane followed with 29% and 22% of households respectively (Table 14). From 1991-1992, when these data were first available, to 1997-1998 the percentage of Vermont households using electricity has declined while the percentage of Vermont households using oil and propane has increased. These changes have been accompanied by Vermont regulatory review which limits the use of electricity in Act 250 projects and low income weatherization services, utility demand side management (DSM) measures which have provided incentives to switch from electricity to another fuel, and the increasing popularity of integrated oil-fired space heat and hot water in new construction (Table 15 and Figure 12).

Figure 12 - Fuels Used for Domestic Hot Water

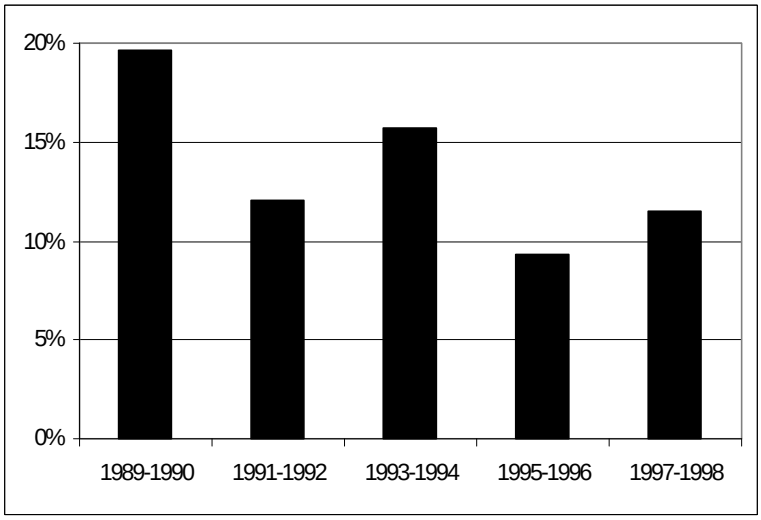


[13]A 95% confidence interval around 3.3% is 1.7% to 4.9%. Statistically, the 1997-1998 percent is different from the approximately 1% of the preceding five years.

Wood Burning Safety

Thirteen percent of all wood burning and pleasure burning households said that the chimney was not cleaned at all the preceding winter; twenty percent said that the stovepipe between the stove and the chimney was not cleaned at all. Among primary wood burners, who by virtue of heavier usage could be expected to need chimney cleaning more often, 8% did not have their chimney cleaned and 9% did not clean their stove pipe during the last season (Tables 16 and 18). Limiting the analysis to households burning wood for space heat, 12% of the 1997-1998 respondents did not have their chimney cleaned.[14] This is a significant decline from the 20% of 1989-1990 households which did not have their chimneys cleaned (Table 17 and Figure 13).

Figure 13 - Percent of Households using Wood for Space Heat that did not have their Chimney Cleaned Last Year



About one half of one percent of the wood burning households reported having to call the fire department due to a chimney or flue fire during the last heating season. Given the very small number of respondents reporting calls to the fire department and the similarity of the frequency of these calls year by year, making firm conclusions about any trend is not possible (Table 19).[15]

Other Energy Usage in the Home

In 1997-1998 for the first time the survey asked about energy used for purposes other than space heat and hot water heat. Several questions were designed to establish the types and number of appliances used in Vermont households (Tables 20 and 21).

One of the fastest growing uses of electricity is air conditioning. The 1998 DPS *Fueling Vermont's Future* forecasted that energy demand for residential air conditioning will increase 119% from 1990 to 2015. This is the largest increase of any residential end use including transportation. In 1997-1998 30% of Vermont households reported having either whole house or window air conditioning.

[14]95% confidence interval is 8.6% to 14.3%.

[15]In 1989-1990 the question was, "Has the fire department ever been called due to a chimney fire?" We would expect a larger number of yes responses to this than to the question asked in the other years, "Was the fire department called either last heating season, or the previous heating season due to a flue or chimney fire?" In 1992-1996 the survey asked if the fire department had been called in either of the preceding two seasons. In 1997-1998 we asked if the fire department had been called in the previous season. For this table the 1992-1996 numbers have been halved to make them consistent with the 1997-1998 tabulation. Note that the estimated number of calls to the fire department in 1993-1994 is considerably higher than in the other years. This may be the result of an unusual sample, but even if it does reflect reality, we see it as unrepresentative of the typical rate.

Appendix I - Tables

Table 1 - Fuels Used for Space Heating in Vermont, 1997-1998

Fuel	Primary Households	% of State	Supplemental Households	% of State	Total Households	% of State
Oil	106,052	47.4%	17,993	8.0%	124,045	55.4%
Wood	36,490	16.3%	33,593	15.0%	70,083	31.3%
Electricity	9,485	4.2%	7,715	3.4%	17,200	7.7%
Propane	32,730	14.6%	11,791	5.3%	44,521	19.9%
Natural Gas	21,884	9.8%	0	0.0%	21,884	9.8%
Kerosene	16,505	7.4%	3,545	1.6%	20,050	9.0%
Coal	215	0.1%	0	0.0%	215	0.1%
Solar	355	0.2%	0	0.0%	355	0.2%
Total[16]	**223,716**	**100.0%**	**74,637**	**33.4%**	**298,353**	**133.4%**

[16]Total households add to more than the state total because households using a supplemental fuel are necessarily counted more than once. Omitted from the total households using a supplemental fuel are approximately 427 households using a fuel other than those listed.

Table 2 - Fuels Used for Space Heat, 1985-1998
Percent of Households Using Each Fuel for Primary or Supplemental Heat
(Does not include wood pleasure burners)

	1985-1986	1987-1988	1989-1990	1991-1992	1993-1994	1995-1996	1997-1998
Oil	116,300	117,300	125,650	123,255	119,759	122,412	124,045
	58.2%	59.5%	61.2%	58.0%	55.1%	55.5%	55.5%
Wood	96,600	78,000	74,552	84,141	82,339	81,402	70,083
	48.3%	39.1%	34.9%	39.1%	37.9%	36.6%	31.3%
Propane	15,300	16,800	34,310	21,861	43,624	40,689	44,521
	7.7%	8.3%	17.0%	10.3%	20.1%	18.5%	20.0%
Natural Gas	13,200	10,100	18,070	19,232	18,880	24,744	21,884
	6.6%	5.0%	8.9%	9.0%	8.7%	11.2%	10.0%
Electricity	31,100	30,000	17,831	31,575	25,288	21,522	17,200
	15.5%	14.9%	7.0%	14.8%	11.6%	9.8%	7.7%
Kerosene	11,800	26,000	10,078	15,854	13,332	14,425	20,051
	5.9%	12.9%	4.8%	7.5%	6.1%	6.5%	9.0%
Solar	1,700	1,800	1,278	7,698	1,365	1,700	355
	0.9%	0.9%	0.4%	3.6%	0.6%	0.8%	0.2%
Coal	4,800	4,400	1,799	513	3,069	2,319	215
	2.4%	2.2%	2.6%	0.2%	1.4%	1.1%	0.1%

Table 3 - Households Burning Wood for Space Heating, 1997-1998

Type of Use	Number of Households	Percent of All Households	Percent of Wood space Heating Households	Cords Burned[17]	Mean Cords per Household
Primary	36,490	16.3%	52.1%	178,495	4.8
Supplemental	33,593	15.0%	47.9%	70,027	2.1
Total Space Heating	70,083	31.3%	100.0%	248,522	3.5
Fireplace Only	5,284	2.4%		1,351	0.3
Total	**75,367**	**33.7%**		**249,873**	**3.3**

[17]The total number of cords burned indicated here is the best estimate calculated by summing the cords burned by primary and supplemental wood burners. This total is not the same as the total calculated by multiplying the mean number of cords burned by the number of wood burning households.

Table 4 - Classification of Wood Burners, Vermont Households

	1981-1982	1983-1984[19]	1985-1986	1987-1988	1989-1990	1991-1992	1993-1994	1995-1996	1997-1998
Not a Wood Burner	79,400	100,100	100,900	110,300	112,234	104,087	123,861	119,048	148,349
	43.1%	52.4%	50.5%	54.6%	54.8%	49.0%	57.0%	54.0%	66.3%
Total Wood Burning Households	104,700	91,000	98,800	91,756	92,574	108,543	93,495	101,331	75,367
	56.9%	47.6%	49.5%	45.4%	45.2%	51.0%	43.0%	46.0%	33.7%
1. Pleasure Burner Only	7,329	4,550	2,200	13,700	18,185	24,402	11,156	19,929	5,284
	4.0%	2.4%	1.1%	6.8%	8.9%	11.5%	5.1%	9.0%	2.4%
2. Burners for Space Heat	97,371	86,450	96,600	78,000	74,389	84,141	82,339	81,402	70,083
	52.9%	45.2%	48.4%	38.6%	36.3%	39.6%	37.9%	36.9%	31.3%
A. Primary Burner	77,478	63,700	73,000	49,800	40,648	53,974	44,176	41,434	36,490
	42.1%	33.3%	36.6%	24.7%	19.8%	25.4%	20.3%	18.8%	16.3%
B. Supplemental Burner	19,893	22,750	23,600	28,200	33,741	30,167	38,163	39,968	33,593
	10.8%	11.9%	11.8%	14.0%	16.5%	14.2%	17.6%	18.1%	15.0%
Total Households	**184,100**	**191,100**	**199,700**	**202,000**	**204,808**	**212,630**	**217,356**	**220,379**	**223,716**
	100.0%	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

[19]To produce tabulations for 1983-1984, we used revised total number of households from the 1987-1988 report along with the percentages published in the 1983-1984 report.

Table 5 - Cords of Wood Burned in the Last Heating Season, Vermont Households

	1981-1982	1983-1984[20]	1985-1986	1987-1988	1889-1990	1991-1992	1993-1994	1995-1996	1997-1998
Total Cords Burned	519,000	424,000	451,000	322,000	277,129	352,112	330,006	295,409	249,873
Cords Burned by Primary Burners	456,720	356,160	386,000	251,000	191,771	279,503	225,711	198,993	178,495
Cords/Primary Burner	5.9	5.6	5.3	5.0	4.7	5.2	5.1	4.8	4.8
Cords Burned by Supplemental Burners	57,090	63,600	64,000	61,000	74,042	64,521	96,946	87,321	70,027
Cords/Supplemental Burner	2.7	2.8	2.7	2.2	2.2	2.1	2.5	2.2	2.1
Total Cords Burned for Space Heating	513,810	419,760	450,000	312,000	265,813	344,024	322,657	286,314	248,522
Cords Burned in Open Fireplace	5,190	4,240	1,000	10,000	11,316	8,088	7,349	9,094	1,351
Cords/Open Fireplace Burner	1.0	0.9	0.4	0.7	0.6	0.3	0.7	0.5	0.3

[20]To calculate the number of cords in 1993-1994, we used the number of cords as revised in the 1987-1988 report and the proportions in the 1983-1984 report.

Table 6 - Heating Degree Days, June 30-July 1, Burlington, Vermont

	1981-1982	1983-1984	1985-1986	1987-1988	1989-1990	1991-1992	1993-1994	1995-1996	1997-1998	Mean
Heating Degree Days (HDD)	8,024	7,790	7,577	7,535	7,496	7,770	8,123	7,667	6,943	7,658
Percent Above (Below) Mean HDD	4.8%	1.7%	-1.1%	-1.6%	-2.1%	1.5%	6.1%	0.1%	-9.3%	
Cords per Primary Burner (CPB)	5.9	5.6	5.3	5.0	4.7	5.2	5.1	4.8	4.8	5.2
Percent Above (Below) Mean CPB	14.6%	8.7%	2.9%	-2.9%	-9.3%	0.4%	-0.8%	-6.8%	-6.8%	

Table 7 - Wood Burning by Type of Residence and Ownership of Residence, Vermont Households, 1990-1998

	Type of Residence				Own or Rent	
	Single Family Detached or Side-by-Side Duplex	Single Family Attached (More Than Two)	Apartment/Condo with Two or More Units	Mobile Home	Own the House	Rent the House
Primary Burner	24.7%	13.4%	3.8%	8.3%	22.9%	9.4%
Supplemental Burner	19.3%	20.0%	4.1%	7.2%	18.9%	6.1%
Pleasure Burner	8.2%	3.7%	6.2%	3.6%	8.2%	3.9%
All Wood Burners	**52.2%**	**37.1%**	**14.1%**	**19.1%**	**50.0%**	**19.4%**

Table 8 - Wood Burning by how Wood was Acquired, 1997-1998

Source	Number of Households	Percent of all Households	Percent of Wood Burning Households	Cords Burned[21]	Percent of Cords Burned	Mean Burned per Household
Self Cut	35,457	15.8%	47.0%	113,899	45.6%	3.3
Purchased Cut and Split	30,599	13.7%	40.6%	94,732	37.9%	3.0
Purchased Unsplit Blocks	4,261	1.9%	5.7%	17,338	6.9%	3.9
Purchased Log Length	5,050	2.3%	6.7%	23,905	9.6%	4.6
Total	**75,367**	**33.7%**	**100.0%**	**249,873**	**100.0%**	**3.3**

[21] The total number of cords burned indicated here is the best estimate calculated by multiplying the mean by the total number of wood burners. This total is not the same as the sum of the estimates of cords burned by how the wood was acquired (242,433) because of the errors involved in estimating the number of people who acquired their wood in the ways indicated.

Table 9 - Wood Burning Appliances and Wood Burned for Space Heat by County[22]

County	Mean Cords Burned per Year for Space Heat, 1989-1998	Mean Cords Burned per Household per Year, 1989-1998	Mean Percent of Households with One or More Wood Burning Appliances, 1989-1998
Addison	19,784	1.64	47%
Bennington	17,674	1.28	34%
Caledonia	22,949	2.04	48%
Chittenden	28,546	0.57	21%
Essex	5,461	2.22	50%
Franklin	14,581	0.98	29%
Grand Isle	1,802	0.77	73%
Lamoille	10,976	1.38	46%
Orange	19,076	1.94	48%
Orleans	22,291	2.35	61%
Rutland	36,268	1.50	38%
Washington	30,005	1.36	37%
Windham	31,954	1.89	52%
Windsor	39,540	1.72	41%
Vermont	**300,907**	**1.55**	**38%**

[22]The 1995 estimate of Vermont households is used to compute theses means.

Table 10: Number of Cords Burned by how Wood was Acquired, Vermont Households

	1981-1982	1983-1984	1985-1986	1987-1988	1989-1990	1991-1992	1993-1994	1995-1996	1997-1998
Self Cut	280,000	187,000	216,000	172,000	103,645	141,828	117,158	113,761	113,899
Total Purchased	239,900	237,000	235,000	150,000	181,659	210,284	212,847	181,648	135,975
Cut and Split	139,900	154,000	115,000	91,000	139,242	144,244	143,050	137,461	94,732
Unsplit Blocks	34,000	33,000	34,000	21,000	12,779	24,807	28,664	23,957	17,338
Log Length	66,000	50,000	86,000	38,000	29,638	41,233	41,133	20,230	23,905
Total Cords Burned	519,000	424,000	451,000	322,000	285,304	352,112	330,005	295,409	249,873
Percent Self Cut	54.0%	44.1%	47.9%	53.4%	36.3%	40.3%	35.5%	38.5%	45.6%
Percent Purchased	46.1%	55.9%	52.1%	46.6%	63.7%	59.7%	64.5%	61.5%	54.4%
Percent Cut and Split	27.0%	36.3%	25.5%	28.3%	48.8%	41.0%	43.3%	46.5%	37.9%
Percent Unsplit Blocks	6.6%	7.8%	7.5%	6.5%	4.5%	7.0%	8.7%	8.1%	6.9%
Percent Log Length	12.7%	11.8%	19.1%	11.8%	10.4%	11.7%	12.5%	6.8%	9.6%

Table 11: Types of Wood Burning Appliances, Vermont Households, 1997-1998

Type of Appliance	Number of Households Using at Least One	Percent of all Households Using at Least One	Percent of Wood Burning Households Using at Least One
Non-Airtight Stove or Insert	11,178	5.0%	14.8%
Standard Airtight Stove or Insert	31,548	14.1%	41.9%
EPA Certified Airtight Stove or Insert	18,835	8.4%	25.0%
Fireplace with no Insert	13,671	6.1%	18.1%
Wood Furnace	11,708	5.2%	15.5%
Combination Furnace	6,085	2.7%	8.1%
Total	**93,025**	**41.6%**	**123.4%**

Table 12 - Wood Burning Appliances Used in the Last Heating Season, Vermont Households

	1981-1982	1983-1984	1985-1986	1987-1988	1989-1990	1991-1992	1993-1994	1995-1996	1997-1998
Air Tight Stove (Not EPA Approved)	51,069	45,590	58,200	50,250	50,486	56,448	35,283	35,794	31,548
	27.7%	23.9%	29.1%	24.9%	24.7%	26.5%	16.2%	16.2%	14.1%
Non Air Tight Stove	13,658	13,494	17,500	19,850	14,366	13,072	14,719	13,923	11,178
	7.4%	7.1%	8.8%	9.8%	7.0%	6.1%	6.8%	6.3%	5.0%
EPA Approved Stove	0	0	0	7,500	9,035	10,306	17,318	21,814	18,835
	0.0%	0.0%	0.0%	3.7%	4.4%	4.8%	8.0%	9.9%	8.4%
Wood Furnace	20,478	15,377	19,200	16,300	16,342	13,582	17,714	14,825	11,708
	11.1%	8.0%	9.6%	8.1%	8.0%	6.4%	8.2%	6.7%	5.2%
Combination Furnace	4,957	3,936	5,200	9,200	7,745	8,444	4,667	4,596	6,085
	2.7%	2.1%	2.6%	4.6%	3.8%	4.0%	2.1%	2.1%	2.7%
Open Fireplace[23]	11,234	6,566	32,300	14,286	54,654	38,997	31,800	19,929	13,671
	6.1%	3.4%	16.2%	7.1%	26.7%	18.3%	14.6%	9.0%	6.1%
Total Heating Appliances	101,396	84,963	132,400	117,386	152,628	140,849	121,501	110,881	93,025
Total Households	**184,100**	**191,100**	**199,700**	**202,000**	**204,809**	**212,630**	**217,356**	**220,379**	**223,716**

[23]In 1995-1996 and earlier this is a tabulation of respondents who identified themselves as fireplace pleasure burners. In 1997-1998 it is respondents who burn wood in a fireplace and did not use any other wood burning appliance.

Table 13 - Households Planning to Install New Wood Burning Appliances, Vermont households, 1997-98

	1981-1982	1983-1984	1985-1986	1987-1988	1989-1990	1991-1992	1993-1994	1995-1996	1997-1998
Households	9,851	13,157	5,000	3,500	1,686	2,122	1,292	1,697	7,452
Percent of all Households	5.4%	6.9%	2.5%	1.7%	0.8%	1.0%	0.6%	0.8%	3.3%

Table 14 - Fuels Used for Domestic Hot Water Heating, Vermont households, 1997-1998

Fuel	Primary Households	% of State	Supplemental Households	% of State	Total Households	% of State
Oil	61,379	27.4%	3,897	1.7%	65,276	29.2%
Wood	4,738	2.1%	997	0.4%	5,735	2.6%
Electricity	87,449	39.1%	3,723	1.7%	91,172	40.8%
Propane	46,416	20.7%	1,647	0.7%	48,063	21.5%
Natural Gas	19,352	8.7%	607	0.3%	19,959	8.9%
Kerosene	3,604	1.6%	0	0.0%	3,604	1.6%
Coal	223	0.1%	0	0.0%	223	0.1%
Solar	555	0.2%	447	0.2%	1,002	0.4%
Total[24]	**223,716**	**100.0%**	**11,318**	**5.1%**	**235,034**	**105.1%**

[24]Total households add to more than the state total because households using a supplemental fuel are necessarily counted more than once.

Table 15 - Primary and Supplemental Fuel for Hot Water Heating, Vermont Households, 1997-1998

	1991-1992	1993-1994	1995-1996	1997-1998
Electricity	102,158	90,921	89,600	91,172
	44.8%	39.8%	40.7%	40.8%
Oil	58,319	58,137	58,353	65,276
	25.6%	25.5%	26.5%	29.2%
Propane	38,463	47,668	48,248	48,063
	16.9%	20.9%	21.9%	21.5%
Natural Gas	16,832	20,942	22,498	19,959
	7.4%	9.2%	10.2%	8.9%
Wood	8,054	7,556	8,749	5,735
	3.5%	3.3%	4.0%	2.6%
Kerosene	383	1,360	2,007	3,604
	0.2%	0.6%	0.9%	1.6%
Coal	1,048	895	1,043	223
	0.5%	0.4%	0.5%	0.1%
Solar	2,886	905	808	1,002
	1.3%	0.4%	0.4%	0.4%
Total	**228,143**	**228,384**	**231,306**	**235,034**

Table 16 - How Often Was the Chimney Cleaned in the Past Heating Season by Type of Wood Burner, Vermont households, 1997-1998[25]

Number of Times Cleaned	Primary Burners	Supplemental Burners	All Burners
Zero	8.4%	15.0%	13.1%
One	47.7%	58.6%	53.9%
Two Times	20.6%	17.2%	17.6%
Three or More Times	23.3%	9.2%	15.4%
Total	**100%**	**100%**	**100%**

Table 17 - Number of Times Chimney was Cleaned in the Last Season, Vermont Households Burning Wood for Space Heat, 1997-1998 (Does not Include "Pleasure Burners")

	1989-1990	1991-1992	1993-1994	1995-1996	1997-1998
Zero	14,556	10,165	14,649	7,596	8,088
	19.6%	12.1%	15.7%	9.3%	11.5%
Once	33,321	41,044	43,505	48,546	37,113
	44.8%	49.1%	46.5%	59.6%	53.0%
2 Times	13,383	19,934	19,972	15,376	13,277
	18.0%	23.6%	21.4%	18.9%	18.9%
3 or More Times	13,130	12,999	15,370	9,884	11,604
	17.7%	15.2%	16.4%	12.1%	16.6%
Total	**74,390**	**84,142**	**93,495**	**81,402**	**70,082**
	100.0%	**100.0%**	**100.0%**	**100.0%**	**100.0%**

[25]Tabulation is restricted to respondents who lived in the same house last year as now.

Table 18 - How Often Was the Stove Pipe Between the Stove and the Chimney Cleaned in the Past Heating Season by Type of Wood Burner, Vermont households, 1997-1998[26]

Number of Times Cleaned	Primary Burners	Supplemental Burners	All Burners
Zero	8.6%	24.5%	19.7%
One	32.8%	40.9%	36.4%
Two	16.2%	16.1%	15.0%
Three or More	42.4%	18.5%	28.8%
Total	**100.0%**	**100.0%**	**99.9%**

Table 19 -Was the Fire Department Called for a Chimney Fire in the Last Year, Vermont Households Burning Wood for Space Heat, 1997-98 (Does not Include Pleasure Fireplace Burners)

	1991-1992	1993-1994	1995-1996	1997-1998
Fires Reported for Wood Space Heat Burners in Last Heating Season	756	2,225	603	354
Fires per 1,000 Space Heat Wood Burners	9.0	27.0	7.4	5.1
Total Wood Burners for Space Heat	84,141	82,339	81,402	70,083
Total Cords Burned for Space Heat	343,629	322,657	286,314	248,522
Fires per 10,000 Cords Burned for Space Heat	22.0	69.0	21.1	14.2

[26]Tabulation is restricted to respondents who lived in the same house last year as now.

Table 20 - Appliance Saturations, Vermont Households, 1997-1998

	Percent of Households with One or More	Number of Households with One or More	Number of Appliances	Number of Appliances per Household Having One or More[27]
Kitchen Range	98.5%	220,267	220,267	1
Clothes Dryer	80.8%	180,704	180,704	1
Refrigerator	99.3%	222,069	249,138	1.12
Freezer	45.9%	102,634	111,448	1.09
Whole House Air Conditioning	2.2%	4,825	4,825	1
Window Air Conditioner	27.3%	61,078	84,595	1.39

Table 21 - Fuels Used, Kitchen Range and Clothes Dryer, Vermont households, 1997-1998

	Electricity	Natural Gas	Propane	Total
Kitchen Range	68.2%	6.6%	25.1%	**99.9%**
Clothes Dryer	90.6%	2.8%	6.7%	**100.1%**

[27]We assume that there is only one range and one clothes dryer per household. We did not ask how many of these appliances exist in the household.

Appendix II - Survey Procedures

This was a telephone survey of Vermont households whose primary residence in the preceding winter was in Vermont. Telephone numbers included in our sample were randomly generated with the result that both listed and unlisted numbers were included. The frame was all qualifying Vermont households with telephones found in blocks of telephone numbers which have at least one listed residential number.[28] The sample was a proportionate, stratified sample: it was selected so that the number of respondents in a county was proportional to the estimated number of households in the county.

We asked to speak with the person who is most familiar with how the house was heated last winter. If that person was not available, we asked for a good time to call back to reach that person. Standard survey protocols applied. The contractor called at different times of the day and different days of the week. Up to ten attempts were made to reach the appropriate person in the household. Up to three attempts were made to convert soft refusals.[29] The contractor achieved a Council of American Survey Research Organizations (CASRO) response rate of 40.8% and an upper bound response rate of 88.5%.[30] The sample size of 482 allows a 95% confidence interval with plus or minus 4.5% width for tabulations using the whole sample.

MACRO International conducted the survey during January and February 1999.

Weighting to Compensate for Unequal Selection Probabilities

Respondents were asked how many telephone numbers could be used to reach a telephone, usable for voice communication, in the household. The inverse of the household's number of phone numbers was assigned as the respondent's weight (e.g., if there were two phone numbers in the household, the respondent's weight would be 1/2.)

Post Stratification Weighting

The county distribution of the sample was compared with the most recent county household estimates from the Vermont Department of Health. The sample age distribution in each county was compared with the U.S. Census estimates of the ages of householders in each county. Sample weights were assigned to make the sample county-age cells have the same proportion of households as the Health Department and Census estimates.

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[28]A block of phone numbers consists of the 100 phone numbers sharing the same area code, the same prefix, and the same first two digits of the four digit suffix. For example, a block would be 802-223-4000 to 802-223-4099. Note that we miss residences which are in blocks with no listed residential telephone numbers. These occur very infrequently; they are costly to find; and their absence is not expected to affects the estimates of the study.

[29]A 'soft refusal' is a refusal which, in the judgment of the interviewer, is more occasioned by the circumstances of the call than by the unwillingness of the respondent to do the interview.

[30]An Upper Bound response rate is defined as:

$$\frac{\text{Completed Interviews}}{\text{Completed Interviews + refusals + terminations}}$$

A CASRO response rate is defined as

$$\frac{\text{the number of completed interviews}}{\text{eligibles + (eligibles * Unknown)/(eligibles + ineligibles)}}$$

Prior Year Surveys

Prior year surveys for which the raw data are still available, 1989-1990 through 1995-1996, were cleaned with standard consistency checks. For the 1995-1996 survey, it was necessary to weight the data to compensate for a telephone book sampling frame in which some areas of the state appeared in more than one book. For these reasons the tabulations here of prior year surveys do not always match the findings published previously. In spite of the data cleaning, data irregularities may exist. Specifically, data from the 1989-1990 and 1991-1992 surveys look somewhat odd. The use of three year moving averages in this report is intended to allow a reasonable presentation of trends even where there are data irregularities.